Reg. No. : | | | | | | | | | | |

Question Paper Code: 31571

B.E. / B.Tech. DEGREE EXAMINATION, NOVEMBER 2015

Fifth Semester

Mechanical Engineering

01UME501 - DYNAMICS OF MACHINERY

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. Define applied and constraint force.
2. Why flywheels are needed in forging and pressing operation?
3. Can a single cylinder engine be fully balanced? Why?
4. State the conditions for static and dynamic balancing.
5. Define critical or whirling speed.
6. What are the different types of vibrations?
7. What is the vibration isolation?
8. Define transmissibility.
9. How governors are classified?
10. What is gyroscopic torque?

PART - B (5 x 16 = 80 Marks)

11. (a) A horizontal steam engine running at 120 *r.p.m.* has a bore of 250 *mm* and a stroke of 400 *mm*. The connecting rod is 0.6 *m* and mass of the reciprocating parts is 60 *kg*. When the crank has turned through an angle of 45° from the inner dead centre, the steam pressure on the cover end side is 550 kN/m^2 and that on the crank end side is 70 kN/m^2. Considering the diameter of the piston rod equal to 50 *mm*, determine:

    (i) turning moment on the crank shaft,

    (ii) thrust on the bearings,

    (iii) acceleration of the flywheel, if the power of the engine is 20 *kW*, mass of the flywheel 60 *kg* and radius of gyration 0.6 *m*. (16)

Or

(b) A single cylinder double acting steam engine develops 150 *kW* at a mean speed of 80 *r.p.m.* The coefficient of fluctuation of energy is 0.1 and the fluctuation of speed is ± 2% of mean speed. If the mean diameter of the flywheel rim is 2 *meter* and the hub and spokes provide 5% of the rotational inertia of the flywheel, find the mass and cross-sectional area of the flywheel rim. Assume the density of the flywheel material (which is cast iron) as 7200 kg/m^3. (16)

12. (a) A shaft carries four masses *A, B, C* and *D* of magnitude 200 *kg*, 300 *kg*, 400 *kg* and 200 *kg* respectively and revolving at radii 80 *mm*, 70 *mm*, 60 *mm* and 80 *mm* in planes measured from *A* at 300 *mm*, 400 *mm* and 700 *mm*. The angles between the cranks measured anticlockwise are *A* to *B* 45°, *B* to *C* 70° and *C* to *D* 120°. The balancing masses are to be placed in planes *X* and *Y*. The distance between the planes *A* and *X* is 100 *mm*, between *X* and *Y* is 400 *mm* and between *Y* and *D* is 200 *mm*. If the balancing masses revolve at a radius of 100 *mm*, find their magnitudes and angular positions. (16)

Or

(b) The following data refer to two cylinder locomotive with cranks at 90°, reciprocating mass per cylinder = 300 *kg*, crank radius = 0.3 *m*, driving wheel diameter =1.8 *m*, distance between cylinder centre lines = 0.65 *m*, distance between the driving wheel central planes =1.55*m*. Determine:

    (i) the fraction of the reciprocating masses to be balanced, if the hammer blow is not to exceed 46 *kN* at 96.5 *km.p.h.*

    (ii) the variation in tractive effort,

    (iii) the maximum swaying couple. (16)

13. (a) The measurements on a mechanical vibrating system show that it has a mass of 8 *kg* and that the springs can be combined to give an equivalent spring of stiffness 5.4 *N/mm*. If the vibrating system have a dashpot attached which exerts a force of 40 *N* when the mass has a velocity of 1*m/s*, find:

(i) Critical damping coefficient
(ii) Damping factor
(iii) Logarithmic decrement
(iv) Ratio of two consecutive amplitudes. (16)

Or

(b) A steel shaft 1.5*m* long is 95*mm* in diameter for the first 0.6*m* of its length, 60*mm* in diameter for the next 0.5*m* of the length and 50 *mm* in diameter for the remaining 0.4 *m* of its length. The shaft carries two flywheels at two ends, the first having a mass of 900 *kg* and 0.85 *m* radius of gyration located at the 95 *mm* diameter end and the second having a mass of 700 *kg* and 0.55 *m* radius of gyration located at the other end. Determine the location of the node and the natural frequency of free torsional vibration of the system. The modulus of rigidity of shaft material may be taken as 80 GN/m^2. (16)

14. (a) A mass of 10 *kg* is suspended from one end of a helical spring, the other end being fixed. The stiffness of the spring is 10 *N/mm*. The viscous damping causes the amplitude to decrease to one-tenth of the initial value in four complete oscillations. If a periodic force of 150 *cos* 50 *t N* is applied at the mass in the vertical direction, find the amplitude of the forced vibrations. What is its value of resonance? (16)

Or

(b) A machine part of mass 2 *kg* vibrates in a viscous medium. Determine them damping coefficient when a harmonic exciting force of 25 *N* results in a resonant amplitude of 12.5 *mm* with a period of 0.2 *s*. If the system is excited by a harmonic force of frequency 4 *Hz* what will be the percentage increase in the amplitude of vibration when damper is removed as compared with that with damping. (16)

15. (a) In an engine governor of the porter type, the upper and lower arms are 200*mm* and 250 *mm* respectively and pivoted on the axis of rotation. The mass of the central load is 15 *kg*, the mass of each ball is 2 *kg* and friction of the sleeve together with the resistance of the operating gear is equal to a load of 25 *N* at the sleeve. If the limiting inclinations of the upper arms to the vertical are 30° and 40°, find taking friction into account and range of speed of the governor. (16)

Or

(b) The turbine rotor of a ship has a mass of 3500 *kg*. It has a radius of gyration of 0.45 *m* and a speed of 3000 *r.p.m*. clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship:

(i) When the ship is steering to the left on a curve of 100 *m* radius at a speed of 36 *km/h*.

(ii) When the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 40 *s* and the total angular displacement between the two extreme positions of pitching is 12 *degrees*. (16)